Open Source Toy Drone

Toy drones and platforms that enable their creation are available as open-source projects, providing access to source code and hardware for learning, research, and customization. Examples include the **ArduBee**, which runs on the **ArduPilot** open-source firmware and is ideal for education, and kits like the **ESP32S2 Quadcopter Kit**, which offers complete access to hardware and software for hands-on learning. These open-source platforms allow users to develop their own drones, run advanced algorithms, and contribute to the development of drone technology.

- Platforms & Software:

1. ArduPilot:

A popular open-source firmware that supports a wide variety of unmanned vehicle hardware and enables advanced functionalities like autonomous flight.

2.PX4 Autopilot:
Another open-source autopilot system used on PixHawk flight control hardware, known for its robust documentation and application in various fields from hobbyist to professional.

- Open-Source Drone Kits:

1. STM32 DIY Drone Kit:
A comprehensive platform for learning quadcopter systems, powered by an STM32 microcontroller and designed for programming in C.

2.Ardubee:
A miniature drone platform based on the ArduPilot open-source firmware, ideal for educational. purposes, research, and swarming applications.
A small, lightweight platform compatible with the CubePilot Ecosystem and built on the ArduPilot open-source firmware.

3. ESP32S2 Quadcopter Kit:
A kit providing access to the source code for a quadcopter based on the ESP32S2 microcontroller, making it an excellent tool for learning programming, electronics, and aeronautics.

- Why Choose Open Source?

*** Learning & Education:**

Open-source platforms provide hands-on experience with programming, electronics, and aeronautics, fostering critical thinking and creativity.

*** Customization & Development:**

Users have complete access to the source code, allowing them to modify, enhance, and develop their own drone capabilities.

*** Community Support:**

Projects like ArduPilot have large online communities that provide help with questions and solutions, ensuring users can get up and running quickly. Large communities of users and developers provide ongoing feedback, contributions, and assistance.

Cost:

Many open-source projects are available free of charge.

*** Research & Innovation:**

Open-source platforms are valuable for research and development in autonomous flight, swarming, and other cutting-edge drone technologies.

*** Flexibility:**
Developers can modify and customize the software to suit specific drone applications.
*** Transparency:**
The open nature of the code allows for understanding and verification of its functionality.

Drones, or Unmanned Aerial Vehicles (UAVs), or "Unmanned Aircraft System" (UAS).
are unmanned aircraft that can be controlled remotely or fly autonomously using onboard software, sensors, and GPS. Once primarily military

tools, they have become popular for various civilian applications, including aerial photography, agriculture, infrastructure inspection, environmental monitoring, and delivery services. Key components of a drone include the frame, motors, propellers, battery, flight controller, and various sensors, which work together to enable stable flight and data collection.

- Key components of a drone:

*** Frame:** The structural body of the drone.
Motors and Propellers: Provide lift and thrust for flight.
*** Battery:** Powers the drone's components.
*** Flight Controller:** A small computer that receives commands and uses sensors to stabilize the drone and control its flight path.
*** Sensors:** Cameras for visual data, GPS for navigation, and other sensors for specialized tasks like environmental monitoring or inspection.

- Historical context:

The concept of unmanned flight dates back to the early 20th century, with early development driven by

military needs for reconnaissance and target practice.
The technology has since advanced significantly, leading to the widespread adoption of drones in both military and civilian sectors.

- Open-source drone controllers:
Open-source drone controllers are software platforms like PX4 and ArduPilot that provide advanced autopilot, guidance, and control features for various unmanned vehicles, allowing for extensive customization and community-driven development. For the ground control station (the interface used to plan and monitor flights), QGroundControl is a popular open-source application that works with these firmwares and the MAVLink protocol.

- Key Open-Source Firmware Options:
*** PX4 Autopilot:**
A professional-grade, open-source flight control software offering flexible tools for drone developers to build tailored solutions. It provides a standard for hardware and software, supporting a wide range of airframes like multicopters and fixed-wing drones.
*** ArduPilot:**
A versatile, feature-rich, and rapidly evolving open-source autopilot for various vehicle types. It boasts a large global community and supports advanced autonomous functionality with real-time

communication through ground control software.
*** Paparazzi UAV:**
An academic-driven, open-source drone firmware.
*** Tau Labs:**
An open-source flight control software that emphasizes safety and flexibility.

- Open-Source Ground Control Stations:
*** QGroundControl:** A powerful, open-source ground control station for planning missions, configuring airframes, and monitoring MAVLink-enabled drones. It is designed for professional users and developers and runs on Windows, macOS, Linux, iOS, and Android.

- How They Work Together:
*** Firmware on the Drone:**
The open-source autopilot software (like PX4 or ArduPilot) is installed on the drone's flight controller hardware.
*** MAVLink Protocol:**
This is a lightweight messaging protocol used for communication between the drone and the ground station.

*** Ground Control Station (GCS):**
An application like QGroundControl runs on a computer or mobile device, communicating with the drone via MAVLink. The GCS allows you to plan flight paths, monitor drone telemetry, and send commands to the vehicle.

- Applications of drones:
*** Photography and Videography:** Capturing high-quality aerial footage for film, news, and real estate.
*** Agriculture:** Monitoring crop health, delivering precision fertilizers, and optimizing resource use.
*** Infrastructure Inspection:** Inspecting bridges, power lines, and other structures for safety and maintenance.
*** Environmental Monitoring:** Tracking wildlife, monitoring forest fires, and studying climate change.
*** Delivery Services:** Transporting goods, emergency supplies, and food to remote or hard-to-reach locations.
*** Search and Rescue:** Locating missing persons and assessing disaster areas.

By: Haytham Zeidan

https://archive.org/details/@wazefapress

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Resources:

https://ardupilot.org/

https://ar.aliexpress.com/item/1005007431889604.html?gatewayAdapt=glo2ara

http://luminousbe.es/ardubee/

https://www.unmannedsystemstechnology.com/2022/03/ardupilot-based-miniature-open-source-drone-platform-unveiled/

https://icaerus.eu/hover-view-open-source-alternatives-in-drone-technology/

https://en.m.wikipedia.org/wiki/PX4_autopilot

https://rcdrone.top/products/stm32-diy-drone-kit

https://www.roboticgizmos.com/ardubee-open-source-micro-drone/amp/

https://en.m.wikipedia.org/wiki/Unmanned_aerial_vehicle

https://www.techtarget.com/iotagenda/definition/drone

https://builtin.com/drones

https://www.sciencedirect.com/topics/engineering/drone

https://www.zenatech.com/drone-technology-basics-guide/

https://umilesgroup.com/en/what-are-the-parts-of-a-drone-full-list/

https://www.mathworks.com/discovery/drone-programming.html

https://www.thedigitalspeaker.com/understanding-drones-innovation-speaker-insights/

https://netlinetech.com/how-drones-are-being-controlled-and-the-way-to-neutralise-them/

https://xrtechgroup.com/how-do-drones-work/

https://qgroundcontrol.com/

https://dronecode.org/projects/

https://github.com/awesomelistsio/awesome-open-source-drone-firmware

https://github.com/PX4/PX4-Autopilot

https://www.spiedigitallibrary.org/conference-proceedings-of-spie/13194/1319402/Real-time-atmospheric-characterization-using-drone-swarms-as-sensor-platforms/10.1117/12.3031729.full

https://wiserbrand.com/drone-software-development/

https://skybrush.io/